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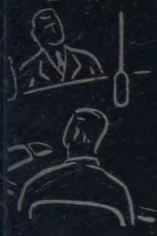

Round Table

CANCER AND RADIATION

An NBC Radio Discussion by
RICHARD H. CHAMBERLAIN
L. H. GARLAND, LEON JACOBSON
and EDITH QUIMBY

Including

ATOMIC HOSPITAL

By LESTER SKAGGS

NUMBER 819 * DECEMBER 20, 1953 * *10 cents*
Yearly subscription $3.00

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RICHARD CHAMBERLAIN, M.D., professor of radiology, member o the staff, University Hospital, University of Pennsylvania

LEO H. GARLAND, M.D., practicing physician, San Francisco; professo of radiology, Stanford University

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ATOMIC HOSPITAL: THE STORY OF ARGONNE CANCER RESEARCH HOSPITAL AT THE UNIVERSITY OF CHICAGO

By LESTER SKAGGS 1

THE UNIVERSITY OF CHICAGO ROUND TABLE

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1030th Broadcast in Cooperation with the National Broadcasting Compan

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The ROUND TABLE, *oldest educational program continuously on the air, is broadcast entir ly without script, although participants meet in advance, prepare a topical outline, and ex change data and views. The opinion of each speaker is his own and in no way involves th responsibility of either the University of Chicago or the National Broadcasting Compan The supplementary information in this pamphlet has been developed by staff research an is not to be considered as representing the opinions of the* ROUND TABLE *speakers.*

The University of Chicago ROUND TABLE. *Published weekly. 10 cents a copy; full-ye subscription, 52 issues, three dollars. Published by the University of Chicago, Chicago 3 Illinois. Entered as second-class matter January 3, 1939, at the post office at Chicago, Illino under the Act of March 3, 1879.*

Cancer and Radiation

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Dr. Jacobson: Essentially there are two methods available which produce a cure of cancer. These are radiation therapy and surgery. The surgical approach is to remove the diseased tissue. Radiation therapy destroys the tissue by bombardment with atomic rays of one type or another. Not all cancers can be cured by either surgery or radiation therapy, or a combination of both, but much can be done in terms of palliation—or, to put it in another way, much can be done to slow down the progress of a cancer or to relieve the symptoms which the cancer has produced.

Radiations from X-ray machines or radium have been used for approximately fifty years. In the past several years there has been a large amount of publicity in the lay press suggesting that we have arrived in a new era in the use of radiations in cancer therapy. This publicity suggests that machines delivering millions of volts of energy are becoming available which will provide a greater cancer cure rate and that radioactive isotopes are available which will be useful when all other means of treatment fail.

In today's Round Table we propose to discuss the role of irradiation therapy in the treatment of cancer and attempt to define the therapeutic limitations of the new and highly publicized supervoltage equipment and radioactive isotopes.

Joining me in this discussion are three prominent, internationally known experts in the use of X-rays, radium, and radioactive isotopes in the diagnosis and treatment of cancer. During this past week the Radiological Society of North America has been meeting here in Chicago, and all of us have been discussing the progress in the practice of radiology. Dr. Garland, what are the new approaches which have promise for the patient?

Dr. Garland: We might try to divide them into three fields—namely, diagnosis, research, and treatment. So far as diagnosis goes, there were three things which struck me at the meeting as being of great interest. One was a series of new methods for examining the coating of the stomach and the colon, using special X-ray opaque media and

new techniques. The second was the use of very high voltage for examining the chest. One doctor showed a series of films made with a two-million-volt machine. And the third was a new method of recording X-rays, so that films will perhaps not be necessary any more. This doctor was using an aluminum plate coated with silenium and secured very fine detailed images on it, which were not permanent records but which were remarkable temporary records which could be used for diagnosis.

DR. JACOBSON: Dr. Quimby, in physics, which is very important to us in the treatment of cancer, are there any new approaches in this field which have some application in therapy?

DR. QUIMBY: The new approaches in this field are particularly new ways or better ways of getting at the radiation. The radiations themselves are not new, and there are no new ones, but there are the super very high-voltage X-ray machines which you mentioned earlier. There are also new machines which are excellent in what we may call "conventional" voltage range, which give us much better ease of using the radiations and much more facility in handling them.

There are the new approaches with radioactive isotopes; the new ways of getting at them; the new ways of using them; and perhaps one of the most spectacular ones is using the atomic-energy pile itself as a treatment agent.

DR. JACOBSON: What about the actual treatment which these new things which Dr. Quimby has mentioned make possible?

DR. CHAMBERLAIN: Those of us who treat patients are very much interested in every new approach. We are fascinated by the possibilities of doing a better job for people who have cancer; but perhaps equally dramatic to us are the studies and evaluations of what we have been able to do over the past many years by more conventional methods of treatment. Perhaps the doctor who is taking care of patients sometimes is most interested in being sure that what he is doing produces a good end result after a period of a good many years. This may not seem quite as spectacular as using the new machines, but it is often more important to a greater number of patients.

DR. JACOBSON: It occurs to me that one of the questions which I would like to have you answer is in regard to the use of these radiations, whether it is supervoltage or ordinary X-ray.

DR. GARLAND: Now, Dr. Jacobson, I hate to interrupt you, but ought we not agree early in the program that the word "super" should be dropped, because it means to many of the profession and the public supereffects; whereas, in actual fact, as you mentioned a few moments ago, the ultra-higher voltage is perhaps a nicer way of giving treatment sometimes, but it does not imply supereffect.

DR. JACOBSON: Yes, I agree.

DR. CHAMBERLAIN: Dr. Garland comes from California, where they are experts on the use of terms "super" and such words; but I think that his point is very well taken. As a matter of fact, there is no magic in any type of radiation which is used for cancer. Our problem really lies in the selective action of radiation on cancer cells as opposed to its action on ordinary cells—or the normal cells—and the fact of the matter is that we can do as good work both in the palliation of cancer and in the curing of cancer with ordinary radiations.

DR. GARLAND: Would you agree that in general the cures which are achieved today in cancer, either by surgery or by radiology, are essentially in the accessible sites?

DR. CHAMBERLAIN: That is largely true.

DR. GARLAND: By that we mean essentially, number 1, the skin; number 2, the lip and mouth and perhaps vocal chords; number 3, the breast; number 4, the neck of the womb; and number 5, the rectum. In three of those sites—namely, skin, lip, and cervix or neck of the womb—radiology will achieve a large number of cures if the patient is seen at all early. In the other two sites, namely, breast and rectum, early surgery brings many cures.

DR. JACOBSON: What importance is it for the surgeon and the radiologist to get together on these problems in terms of treatment?

DR. GARLAND: Of exquisite importance, Dr. Jacobson. But the number 1 man on the team, oddly enough, is not represented on the panel today. The number 1 man is the pathologist. He is the doctor who looks at the piece of tissue through the microscope and, after all, really tells us whether it is or is not a cancer. On his answer depends the decision to use either radiation or surgery.

DR. CHAMBERLIN: That certainly brings up something which is of utmost importance. In modern treatment, diagnosis, and management of

cancer treatment, everything that goes into the handling of the patient with cancer, under the best circumstances, is a teamwork proposition. And you have quite rightly pointed out the important role of the pathologist in this.

But the important thing is cross-consultation with surgeons, as to whether surgery ought to be used in a particular instance, not in the general field, but in the particular patient, and the integration of all these specialists. Sometimes it is decided that the best treatment is neither surgery nor radiation for palliation, at least, or that it may be improved by something about which Dr. Jacobson knows more than the rest of us do.

DR. JACOBSON: I would only like to ask another question. Certain of these cancers can be actually cured with radiation alone, can they not?

DR. GARLAND: Correct.

DR. JACOBSON: Certain of them can be cured with surgery alone?

DR. CHAMBERLAIN: That is right.

DR. JACOBSON: Some of them can be cured only with the two in combination. I wonder if you would not give us some illustrations of this sort of thing.

DR. GARLAND: So far as the lip goes, small cancers of the lip can be beautifully cured by radiation with a nice functional result. The mouth is not distorted, and the cancer is permanently cured. There are many cases on record now where cancers were treated twenty-five years ago and the patients are perfectly well.

In the tongue there are certain sites where a combination of surgery and radiation is very desirable. Sometimes the surgeon, by using either an electrical knife or a conventional cold steel blade, may remove certain portions of the tumor; and then the radiologist may implant radon or radium seeds, or even some of the new radioactive isotopes into the remaining root of the tumor, as it were.

In the breast the surgeon does the best job. He cures many, many breast cancers, when they are caught early. When they are a little more advanced, he uses the radiologist to follow up the surgery to try to destroy any remaining seeds of cancer in the lymph glands in the neck or armpit.

DR. JACOBSON: Dr. Quimby, in this connection, in terms of trying to destroy the seeding which has occurred from cancer, what are some of the things which we actually use to destroy these implants?

DR. QUIMBY: Of course the oldest weapon and perhaps the best weapon still is X-rays, radium, and now some of the newer radioactive isotopes. But the point is not whether it is an X-ray tube or a radium tube or an isotope; it is the fact that it is the radiation being put where the cells are that you want to affect.

DR. JACOBSON: One other thing which we ought to bring out at this point is that one of our great difficulties at the moment is to determine whether or not the cancer may have spread to other parts of the body and whether there is any actual need for treatment beyond the site at which the cancer can be found by one method or the other. We ought to say something about what radiations are and how they are used in cancers.

DR. QUIMBY: It is very difficult to be dogmatic about what radiations are, but perhaps two of the easiest ways to think about them is to compare them with things about which we know. X-rays and the rays from radium are not different—not very different—from ordinary light; and everybody knows that if you go to the beach and get sunburned, the light does something to your skin, but it does not go deeper. Now, X-rays and the rays from radioactive substances will go through the skin and produce effects on deep-lying tissues. So that it is just all part of the same family. It is just more powerful radiations with which we are concerned in treating these cells.

Another way which we could look at it is that everybody has gone to a radiologist and had a chest X-ray—or almost everybody has. Now the X-rays which are used to make these radiographs are the same sort of thing as the X-rays which are used in cancer treatment, but the ones which are used in treatment are more powerful, and we use more of them. It is just a difference in degree and not in kind.

DR. CHAMBERLAIN: Another very important field, though, which you contribute to this use of radiations is in telling us how much radiation we are using and how much gets down to the tissues, to the deep-seated cancers, or to the superficial cancers which we are trying to treat, too.

DR. QUIMBY: In cancer therapy this is the function of the physicist, I think. It is the accurate measurement of the radiations. Then the phy-

sician must be able to consult with the radiologist to find out the bes way to get the radiation where he wants it.

DR. JACOBSON: As, in a sense, a lay person here—really I am not radiologist—I can ask the question that has been suggested in the news paper. Are these new forms of therapy going to be helpful, because on can get larger doses within the body to a tumor and less in a sense t the skin, which is, I understand, an important problem. What is mean by this?

DR. CHAMBERLAIN: The limiting factor in most treatment of cancer i not the getting of radiation to the cancer. This does occur; there ar special instances where this is a major problem. But our problem i those cases where we cannot cure is largely one of not being able to ge radiation to go to the cancer cells only, but also it irradiates the norma tissues about the cancer to a level where one cannot go any higher wit the amount of radiation. However, it is quite true that, with the radia tions from higher energies—Dr. Garland will not let me say "super voltage" but it is so imbedded in our general line of talking that it i hard to avoid using the term. . . .

DR. GARLAND: "Ultra-high" voltage would be permissible.

DR. CHAMBERLAIN: All right, thank you. Nevertheless, there are spe cial situations where the possibility of getting a little more radiation int the deep-seated cancer is so important for the individual patient tha this is worth any amount of time and trouble as well as money.

DR. JACOBSON: Will the new so-called cobalt bombs, with rotationa therapy, accomplish this for us?

DR. QUIMBY: They will to a certain extent. I was going to say that th thing not to lose sight of is that it is not necessarily higher voltage which are going to do the work, but better attention to the voltages w have. We can do a lot more with the X-ray machines which we have we will use them to the best of their advantage. This is one of the thing which I think new equipment is helping us to do.

DR. CHAMBERLAIN: It is awfully nice for Dr. Quimby to say this. I wa going to say that the doctor who is doing the treatment is more impo tant than the machine or the kind of apparatus or isotope which h is using.

DR. QUIMBY: There is no question about that.

DR. GARLAND: Would you not agree, Dr. Chamberlain, that from th

oint of view of the average person throughout the country today who oes to his family doctor with a cancer, and that doctor decides that adiation therapy should probably be used and consults the local radiolo- ist, do you not think that probably 90 per cent of the cancers seen in ractice today could be handled with what you call conventional oltage?

DR. CHAMBERLAIN: That is absolutely true. I would think that we nust not be blinded by the romance, if you want to put it that way, ssociated with very high-energy radiations and with the products of tomic-energy piles to the point of forgetting that the great majority of ancers can be perfectly adequately treated by conventional radiation.

DR. JACOBSON: What do you mean by "conventional radiation"?

DR. CHAMBERLAIN: Of course, by "conventional," I mean what I am ised to. But even these machines, the machines which most of us have, o which Dr. Garland was referring and which the doctor might have n a relatively moderate-sized community, are in themselves marvels of engineering and of the application of physics. They simply operate at a quarter of a million volts instead of two million volts, most often.

DR. JACOBSON: Actually then, the difference is the difference between 250,000 volts and 2,000,000 or 50,000,000, something of this order.

DR. CHAMBERLAIN: Of course, nowadays you have machines which are used for research purposes which go up to several billion in volts, so the sky seems to be the limit on what we can achieve.

DR. JACOBSON: Our discussion has been oriented in the terms of the diagnosis and treatment of cancer, and we have, in a sense, been talking a great deal about the cure of cancer. Perhaps one of the most important aspects at the moment, since we know so very little in a sense about what cancers are, is palliation—in other words, attempts to make the patient more comfortable and more useful as a citizen. What do we do in terms of palliation?

DR. GARLAND: Let us take a very common cancer—namely, cancer of the breast. It is estimated that about two-thirds of women with these tumors come to the doctor when reasonably vigorous attack can be made on the tumor, either by surgery or radiation or by both methods. But about one-third come when the tumor has already spread beyond the local site. It has spread perhaps to the bones, or the lungs, or some other areas. The patient may or may not have some pain or rheumatism

or a cough. In those cases the proper use of palliative radiation can make life very much more comfortable; it can prolong life; and occasionally, combined with the patient's own natural resistance to the tumor, it can give very long survival time.

Of course there are many other sites we might illustrate. We might mention cancer of the lung. We might mention cancer of the bladder; cancer of the kidney; and even cancer of the brain. In selected cases of those various tumors, considerable palliation can be obtained by the wise use of radiation therapy.

DR. CHAMBERLAIN: As a matter of fact I think that it is hard to define just what palliation is sometimes. If you can make a patient so comfortable that he can lead a useful, happy life, sometimes this is almost as good as what we would call a scientific cure.

DR. GARLAND: Yes. I agree with you. All four of us here at the table have seen an occasional patient with Hodgkin's disease who, by means of small doses of X-rays, has lived and worked ten or fifteen or twenty years even. There are, of course, cases of leukemia on record, chronic, shall we say, benign leukemia, where the patient has been kept alive with small doses of X-rays or isotopes, as the case may be.

DR. JACOBSON: In addition to attempting to cure these cancers with radiation, to diagnose them more adequately, and to provide palliation, we have to give credit to what we call "adjuncts" to radiation and surgery—in other words, those things which we use almost every day to make the patient more comfortable. I would like to say something about blood transfusions, for example; the use of antibiotics; and the use of ACTH and cortisone in making the patient feel in a better state, even though the disease might very well be fairly far advanced.

DR. CHAMBERLAIN: Did you mention the nitrogen mustard group of drugs? After all, they are your own specialty, Dr. Jacobson.

DR. JACOBSON: Yes, I suppose we should mention them, especially in terms of the diseases of the lymphatic tissue, Hodgkin's disease, the leukemias, and the like. They are probably of some importance. In this connection there are some individuals who feel that actually the combination of radiation and, in a sense, chemotherapeutic agents offer something to the patient. Actually this perhaps is not proven as yet but remains to be looked into in the future.

DR. GARLAND: How about the sex hormones? Do you not think that

We ought to mention that steroid hormones, notably endrogens and estrogens, so called, are very useful in certain cases of cancer of the prostate, cancer of the breast, and in research fields now, experimentally, in cancer of the cervix and even lung.

DR. JACOBSON: Yes. I think that that field is very important. In a sense they are adjuncts and are gaining more and more importance in the treatment of cancer.

We ought also to say something about what we do have coming up in the way of research which would give us any hope or enthusiasm for the future in terms of the treatment of cancer. For example, there are the radioactive isotopes.

DR. CHAMBERLAIN: We have all here today gone to some little trouble, perhaps, not to play up the role of new developments in the practical treatment of patients over and above the place which should be given to them. On the other hand, I do not think that we should forget that it takes a lot of enthusiasm to do research; it takes a lot of hard work to do research; and that this enthusiasm has to be restrained with good common sense applied to the results when it comes to dealing with human beings, because we do not experiment with human beings.

But when we have situations where the conventional tools—I am avoiding the term "conventional radiation"—but conventional methods are no longer able to do what we want in controlling cancer, then I think we are justified in trying new methods. And this is the type of thing in which some of the most hopeful prospects for the future are coming out.

DR. QUIMBY: Should we perhaps in addition say a little about the possibilities of what we call "pure research"—not things which are immediately applicable to the treatment of cancer. But if we can find out how radiation acts on living cells, if we can find out how and why cancer cells differ in their reactions, either to radiation or to the adjuncts from the normal cells, this is basic research. It will not next week or next year cure cancer, but it may lead to some great improvements.

DR. CHAMBERLAIN: It certainly will. Interestingly enough, probably one of *the* most useful tools, if not the greatest boon in the last century for this basic research, has been the use of radioactive isotopes for basic research and not for treatment.

DR. QUIMBY: That is right.

DR. GARLAND: Let us roll the curtain up a little higher even. Let us say that by judicious use of present knowledge we will be able to prevent certain types of cancer. We now know, for example, that we can prevent cancer of the bladder in people who handle certain analine dyes. We know that we can prevent cancer of the bone in people who handle radium. There have been various other industrial cancers, the nature of which has been solved, and we now can prevent those. Perhaps we will find ways of preventing cancer of the stomach and of other internal organs, where it is so hard to cure them today.

DR. JACOBSON: We have to say that there is just simply no question about the need for research in the cancer field.

DR. CHAMBERLAIN: Too, we must go on to say that we are using materials like radioactive iodine to treat cancer in living human beings and are doing a wonderfully successful job in certain selected cases for it. We must not lose sight of the fact that already some of this important application of research has come to fruition in the treatment of patients.

DR. JACOBSON: I would like to ask Dr. Garland about the work on sensitizing tumor tissue.

DR. GARLAND: That is so exciting that it is almost hard to mention it. Apparently, by the use of certain hormones or certain chemicals, a few cancers have been sensitized, so they can be more easily controlled with doses of radiation. Now, if that is true, and if it can be extended to other cancers, then we have a marvelous weapon for making some deep-seated cancers sensitive to tolerable doses of radiation.

DR. JACOBSON: I might say, in conclusion, that radiation therapy and/or surgery are still the treatment of choice for most cancers. Improvement in the techniques of applying radiation therapy has accomplished a great deal in increasing the cure rate and in alleviating the symptoms of cancer.

The new high-energy or ultra-voltage machines which are now being introduced are still in the experimental stage. Whether the cancer-cure rate will be increased by their use remains to be settled in the future. Radio isotopes have a definite place in the treatment of a limited number of cancers; but it should not be expected that widespread application of these isotopes to the cancer-treatment field will occur very soon.

Cancer diagnostic methods, using ordinary radiations and radioactive isotopes, are likley to become even more significant than they are at present as further technical advances are made.

ATOMIC HOSPITAL[1]

By LESTER SKAGGS

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Completed after nearly three and one-half years of building, the Argonne Cancer Research Hospital stands as the latest addition to the University of Chicago's center of medical and biological research.

This new hospital was built by the Atomic Energy Commission on land leased from the University of Chicago. The purpose of the Commission in establishing this hospital was to provide superior facilities for treatment and study of neoplastic diseases with radiation, including both radiations produced artificially by man-made machines and those produced by radioactive materials. The hospital is to be regarded as a research hospital in every sense of the word and is not to be used for the treatment of common diseases or even for the treatment of cancer by methods already established.

The hospital is operated by the University under a contract similar to but not part of the contract for the operation of the Argonne National Laboratory. Nevertheless, there will be close co-operation with the Argonne Laboratory, and the participating institutions of the Argonne Laboratory will have the privilege of sending qualified physicians and scientists to the hospital to engage in selected research problems. However, the responsibility for individual patients will rest with the faculty of the School of Medicine of the University.

Responsibility for the scientific program and the efficient operation of the hospital rests with the dean of the Division of the Biological Sciences, Lowell T. Coggeshall. The responsibility for the day-by-day administration of the hospital has been delegated to the director, Leon Jacobson, professor of medicine in the University. Dr. Jacobson is specifically responsible for the selection and planning of the research program, appointments to the professional staff, assignment of space and facilities, and development of the budget. He is also responsible for the development and enforcement of the regulations for control of radiological and other hazards to patients and staff and for direct control of classified documents. The director is assisted in his duties by the asso-

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ciate director, Robert J. Hasterlik, assistant professor of medicine. In addition, Dr. Hasterlik has responsibility for research programs conducted jointly with the Argonne Laboratory and for the relations with participating institutions of the Argonne Laboratory. Responsibility for furnishing such administrative, nursing, housekeeping and dietary, engineering, and other allied services as are required for operation of the Argonne Hospital rests with the superintendent of the University Clinics, Ray Brown, and with the administrative assistant to the director, Richard Wittrup.

The new hospital is located on Ellis Avenue and adjoins Goldblatt Cancer Hospital on the south. There are seven floors above ground, including the mechanical equipment attic, and two floors underground. Total floor area is approximately 100,000 square feet. The building was built at a cost of $2,720,000. The equipment will add approximately $1,100,000 to this figure.

The seventh-floor attic is filled from end to end with blowers, ducts, filters, and other equipment required for the many hoods used throughout the building.

The sixth floor is the only completely air-conditioned floor in the building. On this floor, Eric Simmons, assistant professor in the Institute of Radiobiology, will operate the animal farm, maintaining a stock of mice, rats, rabbits, and guinea pigs. He will supply animals to research people as needed and will maintain the animals for observation after injection with radioactive materials, treatment by X-ray, or other research operations. Largest use will be made of mice, and approximately a thousand LAF_1 hybrid mice will be produced each week. These mice are used very widely in radiation experiments because the uniform hereditary factors make their response much less variable than that of ordinary mice. This floor also contains such special facilities as two 250-kilovolt X-ray therapy machines built by General Electric and supplied with special floor-to-ceiling mounts, making possible a large uniform field of radiation. Diagnostic X-ray machines will also be installed for animal experimentation. An animal operating room is located on this floor, and special facilities are provided for the injection and maintenance of animals receiving radioactive materials. Latest and most up-to-date facilities are provided for maintaining and washing cages and handling a large supply of animals.

A number of activities are centered on the fifth floor. James W. J. Carpender, associate professor of radiology, will have his mold-prepara-

tion laboratory here, where he will prepare special molds for use in radiation therapy. Near by is a radiation physics laboratory which will be used both as a facility for research in radiation physics and as a teaching laboratory. Residents in radiology will have an opportunity to brush up on their physics in this laboratory and also to learn the latest techniques in measuring high-energy radiation and in evaluating the quantity of radioactive materials.

Other research programs located on the fifth floor are devoted to studies using radiocarbon (carbon-14), radiohydrogen (hydrogen-3, or tritium), and radon. Most of the studies will be concerned with the metabolism of patients and animals with cancer of one sort or another. The radioisotopes will be used to label and trace chemical substances that are concerned with either the growth or the destruction of tumor tissue. A portion of the fifth-floor space is used for laboratories for organic synthesis of carbon-14 and tritium-labeled compounds for use in the program. Specialized equipment for advanced biochemical and biophysical research is located on this floor and will be used jointly by the research groups. Four groups are working there at the present time. Professor Weldon Brown of the chemistry department is responsible for a group concerned with the synthesis program; George V. LeRoy, associate professor of medicine and associate dean of the division, with George Okita, research associate in pharmacology, and Harold Werbin, research associate in medicine, will conduct the metabolic studies; Eugene Goldwasser, research associate in biochemistry, and his group are concerned with biochemical problems; and Dr. Hasterlik's group will study patients with radium poisoning and with other sorts of radiation injury.

The laboratories handling radioactive materials on this floor, as well as in other parts of the hospital, are specially equipped. All laboratory benches, cupboards, cabinets, etc., are of stainless steel. Special hoods designed and developed by Argonne National Laboratory are installed for handling radioactive materials where there is danger of air contamination. The floors are covered with a vinyl sheet which is easily decontaminated. All laboratories in this area are air-conditioned.

Outside this area are the health physics laboratories, Dr. Hasterlik's office, the medical physics office, and the special counting laboratories. The counting laboratories are located at the north end of the building, removed as far as possible from sources of radioactive materials. They are equipped with all the latest devices for detecting and measuring

radioactive materials. The health physics laboratories serve as a base of operation of the group charged with protecting University personnel as well as the general public from dangers of excessive radiation. This group establishes procedures for handling radioactive materials, surveys the laboratories for contamination, supervises decontamination where necessary, and assists in the disposal of radioactive wastes. It also checks on the weekly exposure to radiation of University personnel, generally by means of film badges, but sometimes by special ionization chambers.

The third and fourth floors are hospital floors and together have fifty-six beds, thirty on the third floor and twenty-six on the fourth. These two floors are practically the same except that on the fourth floor there is a small operating room and a dietary kitchen, and on the third floor a special shielded room for surveying patients with tracer doses of radioactive materials. Most of the rooms are semiprivate, each with its own bath and lavatory. Each room is provided with a small closet for the patient's personal clothing. The rooms are decorated in pastel shades, each with two different contrasting colors. It is said that 285 separate shades of colors were used to decorate the entire hospital. Curtains are different in each room, and they, with the bedcovers, are chosen to harmonize with the walls. The beds on these floors will all be electrically operated.

The floors are covered with vinyl sheeting to aid in decontamination; and the rooms are shielded from each other by 8 inches of concrete, the shielding being desirable to prevent the build-up of radiation from a number of patients. Under the present plans, the third floor will be used for those patients who receive radioactive materials; the fourth floor, for those who are being treated with the machines in the sub-basement.

Special procedures are necessary in the handling of patients receiving radioactive materials. These patients are cared for by a special nursing staff under the direct supervision of Miss Rosemary Haughey, who has had experience at Memorial Hospital in New York and at Oak Ridge with patients receiving radioactive materials. Patients selected by the medical staff for admission are handled routinely. Actual administration of radioactive isotopes is, of course, by the physician handling the case or his staff. Twenty-four hours' notice of intent to administer radioactive materials is required in order to give the nursing staff and health physics opportunity to make proper preparations. Baths and as much care as possible are given the patient just before the administration of

radioactive material so that nursing care during the critical period after administration may be reduced to a minimum.

Elaborate precautions are taken to prevent the spread of contamination through the building. Great care is taken to protect the health of the medical and nursing staff. For instance, the length of time the same personnel may treat patients with gamma-ray emitters has been carefully determined, so that the staff will not be exposed to an accumulated dosage beyond the point of tolerance. Film badges are, of course, used to check the amount of radiation received by each person, and, in some cases, ionization chambers are also provided. Control of contamination is important both from the standpoint of health and from the standpoint of the research activities which are carried on in other parts of the building. Where the spread of contamination is likely, all persons entering the room are required to wear gowns and rubber gloves. In special cases, plastic overshoes are also required. All linen used on isotope patients is collected separately, placed in paper bags, and labeled with the name of the patient and the isotope used. This linen is then taken to the basement where it is checked for possible contamination before going into the regular laundry. Wherever practical, instruments are washed and then set aside until the radioactivity has decayed. Food is brought up to the floor from the main dietary kitchen in large electrically heated carts and served there. Dishwashing facilities are provided on the floor in order to prevent spread of contamination to the central facilities. All radioactive wastes are collected separately and disposed of by health physics. The floor is monitored daily by health physics, and every spot of contamination is removed immediately. So far, it has been possible to keep the corridors clear of contamination, thus making it possible for the staff to move about freely. Visitors are normally not allowed during the first forty-eight hours after administration of a radioactive isotope. This regulation is not so much for the protection of the visitor, since he will not receive repeated exposure over a long period of time. Rather we are concerned about the possible spread of contamination through the hospital.

So far, radiogold (gold-198), radioiodine (iodine-131), radiochromium (chromium-51), and radiophosphorus (phosphorus-32) have been used on patients on this floor. Radiochromium has been used in tracer doses and has not presented any problems. Radiophosphorus and radioiodine are given in larger therapeutic doses and have resulted, in some minor cases, in contamination. Radiogold has been used in mas-

sive therapeutic doses, being injected into the pleural or the peritoneal cavities. As much as 150 millicuries have been given at one time. Material is received from Abbott Laboratories packed as individual doses in serum bottles and properly shielded for shipment. Injection is through a plastic tube and needle inserted into a serum bottle, the gold solution being displaced by normal saline. So far, this method has given very good results, only a minor amount of contamination resulting from the normal procedure. One accident was experienced in which the plastic tube burst and contaminated the bed clothing. We are, of course, far from having any conclusive clinical results, but we are gaining experience in handling patients on a large scale who are receiving this type of treatment.

On the second floor are the offices and laboratories of Dr. Jacobson and Dr. Dwight Clark, professor of surgery. Dr. Jacobson's staff is concerned with hematologic investigation, both clinical and research, and problems pertaining to radiation injury and protection. Tracer studies with radioiron (iron-59) and radiophosphorus are in progress. Dr. Clark's group is studying thyroid chemistry and physiology with radioiodine and by chromotography.

Some of the administrative offices are located on the first floor. A large conference room is provided which can be divided into three smaller rooms by folding partitions. The electronics shop and the machine shop are also located on this floor. These shops are provided to develop and build special instruments and devices required in research being conducted in this building. The electronics shop is under the direction of Donald Charleston; the machine shop under John Stupka. These men are familiar enough with the construction and function of equipment in their particular fields to assist physicians and biological scientists in the design of apparatus for their particular projects. The electronics shop provides space for up to six electronics technicians, and the machine shop up to eight machinists. Adjacent to the machine shop is the radiology shop, under the direction of Paul C. Hodges, professor of radiology. It is used for the development of new equipment for research in diagnostic and therapeutic X-ray.

The basement contains laboratories for the chemical processing of large quantities of radioactive materials. It is expected that eventually a cave will be installed on this floor providing for the handling of 10–100 curies of radioactive materials by means of remote manipulators. Directly adjacent to the space reserved for the cave is the tube-storage facility

or radioactive isotopes. Here forty stainless steel tubes 8 inches in diameter extend 8 feet below the floor in a solid block of concrete. Radioactive materials to be stored here will be placed in lead containers approximately 2 feet long with a diameter to fit the tubes. The lead containers will be sufficiently thick to shield the individual lot of radioactive material. The concrete shield surrounding the tubes will prevent the radiation from many containers from building up to dangerous levels. A large laboratory on this floor will be provided to receive radioactive materials and handle their distribution. This laboratory will be in the charge of a registered pharmacist under *The Clinics* pharmacy. All materials for clinical use will be dispensed by this laboratory in the exact amount required. Certain materials in common use will be stocked and will also be available for research purposes. Several other laboratories are available on this floor as well as a counting laboratory. Locker rooms are provided for personnel requiring a change of clothing, and stockrooms are located here. A linen-sorting room is also located on this floor. Here linen from the hospital floors and from the laboratories will be inspected by geiger counters for evidence of contamination. Where contamination is found, proper measures will be taken to remove the contamination and the article will be run through an automatic washing machine and drier before it is sent to the central laundry. Where contamination cannot be removed, the article will be stored until its active material decays or until it has to be destroyed.

The subbasement of the Argonne Hospital is located 19 feet below the street. This is 12 feet below the permanent water table, and special methods of construction were necessary to keep this area dry. Much of the mechanical equipment for heating the building, providing hot water, compressed air, etc., is located on this floor. There are twelve 1,200-gallon glass-lined retention tanks on this floor. These are provided for each of the floors where radioactive isotopes are used. These tanks may either be emptied into the normal sewer or pumped into a tank truck for transportation to the Argonne National Laboratory in the event that the contents of the tanks are so radioactive that they cannot be discharged into the city sewers. At the Argonne Laboratory the material will be concentrated by evaporation, and the resulting solid radioactive material will then be buried. On this floor, two constant irradiation rooms are provided for the constant irradiation of animals and the study of chronic effects of radiation. Also lo-

cated on this floor are the large machines for the treatment of patient with radiations.

First to be installed of these machines is the Van de Graaff generator. This is a 2-million-volt electrostatic generator of X-rays. It will be used to study the effects of supervoltage X-ray on cancer and also to study the advantages of rotational therapy. Rotational therapy is a type of therapy using an external source of radiation which, by rotation about an axis through the tumor, builds up radiation destruction throughout the region of the tumor to a maximum while regions outside, due to their intermittent irradiation, receive a smaller amount. Also, it will be possible to bring the electron beam to be used in biological experiments out of the Van de Graaff. These electrons may turn out to be directly useful in the treatment of cutaneous cancers since the penetration of tissue is approximately one centimeter.

Second to be installed will be a cobalt-60 rotational therapy machine. This machine will use an 1,800-curie source of cobalt-60 and will rotate the source about a horizontal axis. A reclining patient can then be placed with his tumor on this axis and receive rotational therapy. The advantage of this machine over the Van de Graaff generator is that the patient can be irradiated in a reclining position, making it easier to locate the center of the tumor. Also, accuracy of location will be improved by placing the patient in a half-cast and taking X-ray radiographs of the tumor region before irradiation starts. Then, from study of these radiographs, it will be possible to locate the patient accurately in the cobalt-60 machine. Besides rotational therapy of reclining patient, two other features of this machine are unique. First it is the only machine to use uranium as a shield. This reduces the weight of the shield from approximately 4,000 pounds to 950 pounds. It also reduces the over-all size of the machine and gives a larger output of radiation to the tumor from the same size source. The other unique feature is the size of the cobalt source. This will be three-quarters of a centimeter in diameter and 3 centimeters long, and this small size will be made possible by the fact that the source will be activated in one of the newest Atomic Energy Commission reactors at Arco, Idaho. The use of this very small source is advantageous because it reduces the region of penumbra to a minimum. With this source, the penumbra, that is, the distance from essentially full irradiation of the tumor to essentially no irradiation of the surrounding tissue, will be approximately 1 centimeter. This machine is now being designed

y Lawrence Lanzl and Don Davison and is being built in our hops and those of the Argonne National Laboratory.

The third machine to be installed in the subbasement is a linear ccelerator. This machine will accelerate electrons to an energy of 0 million volts, at which energy they will have sufficient penetration o pass entirely through the body. These particles will be used irectly in the treatment of cancer. They are advantageous because ney give a more favorable distribution of ionization and therefore of estructiveness with depth. No unusual biological effects are expected ith electrons, since the actual agents of tissue destruction in the case f X-rays are the electrons which are expelled from the atoms of ssue by the photons as they pass through that tissue. Contracts have een entered into for the design and construction of the linear ac-elerator, and it is expected that the machine will be completed in pproximately a year.

Medical work on another machine is also being supported by the rgonne Hospital. This is the 450-million-volt proton synchrocyclo-ron located in the Accelerator Building. Work on this machine is eing supported by the Argonne Hospital because it, together with esources to be provided in the hospital, will give practically a com-lete coverage of all types of radiation which are now known and hought to be useful in cancer therapy. Protons will be used directly nd are expected to be advantageous because of the very favorable istribution of dose. However, their biological effects are as yet only ncompletely known, and considerable study will be necessary before ney can be applied to the treatment of cancer in humans.

The Argonne Cancer Research Hospital offers the University of hicago Clinics yet another chance to pioneer in a new field of nedicine. It offers the student of the University of Chicago School f Medicine yet another opportunity not only to see the various new nethods of treatment but also to understand the value of research. nd it offers the Atomic Energy Commission the chance to dem-nstrate that the atom can be applied to the service as well as to the estruction of mankind.

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